

FUNCTION MODULE INSTRUMENTATION



CEC

DEVAR-KINETICS DIVISION

CONSOLIDATED ELECTRODYNAMICS / A SUBSIDIARY OF BELL & HOWELL



FUNCTION MODULES

... A new approach to analog control system design

CONCEPT

Using a new building-block approach, CEC/Devar offers a revolutionary idea in analog control system design. Separate encapsulated modules each perform a specific function to provide limitless design flexibility plus the inherent reliability of solid-state encapsulated circuits—all at the lowest cost on the market.

OPERATIONAL AMPLIFIER PRINCIPLE

CEC designed operational amplifiers are used as the basic elements from which Function Modules are constructed. Use of the operational amplifier principle makes possible the employment of the most advanced analog computer techniques. Arranged in appropriate sequence, operational amplifiers compose modules having the full range of functions offered—and they perform with high-order analog computer accuracy.

EASE OF APPLICATION

A fundamental advantage of Function Modules is their ease of application. This applies equally during system planning and description, through the construction, testing, and installation phase, and

ultimately in operation and maintenance. Furthermore, the design of custom systems is simple and straightforward.

Features that contribute to the ease with which modules may be employed include provision of a wide scope of functions without missing links, absence of nuisance functions such as sign inverters, the use of straightforward internal design for Function Modules that adheres to widely accepted circuit standards and textbook principles. Additional features are the use of direct-reading coefficient potentiometers, and digital coefficient selectors which eliminate the need to mount and wire separate selector switches. All coefficient resistors mount directly onto Function Modules.

Function Modules are employed in logical sequence which simplifies both testing and operation. System wiring is extremely simple by following a function block diagram on each module.

RELIABLE OPERATION

Maximum reliability is another key advantage of Function Modules, making them particularly well suited for use in systems required to deliver continuous service, and where severe industrial en-

vironments are encountered.

To assure the highest reliability, internal solid-state electronic components are protected by a tough Lexan module shell. Circuits are cleaned, mounted, encapsulated, operated for at least 50 hours, and finally tested before shipment. Only reliable screw-type terminals are used and troublesome plugs, trimmers, switches, and exposed circuits are all eliminated.

UNIVERSAL APPLICATION

Function Modules are offered to perform a full range of individual functions. Singly or in combination, they may be used to accomplish signal conversion, solve algebraic equations, provide transfer functions, or act as arbitrary function generators.

Modules are used in standard instruments manufactured by CEC/Devar and are completely compatible with instruments manufactured by others. CEC/Devar standard instruments include controllers, recorders, amplifiers, and monitors. Furthermore, Function Modules are ideal for inclusion in custom systems such as control computers, measurement calculators, process simulators, process analyzers, and data reducers.

FEATURES

Flexibility:

Modules can be used in many combinations.

High Performance:

Each module's "as new" capability is sealed in.

Highest Reliability:

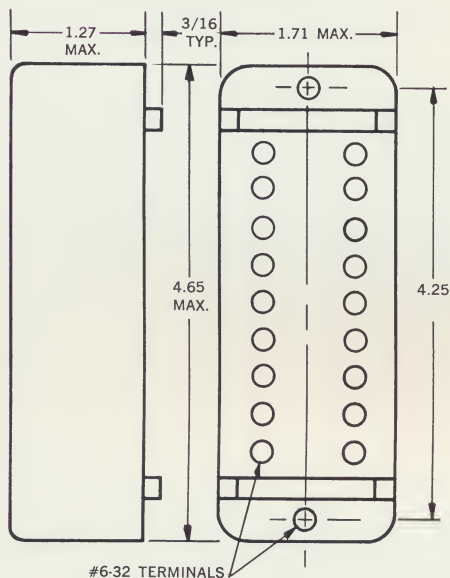
Even corrosive atmospheres, vibration, and shock will not damage components.

Low Cost:

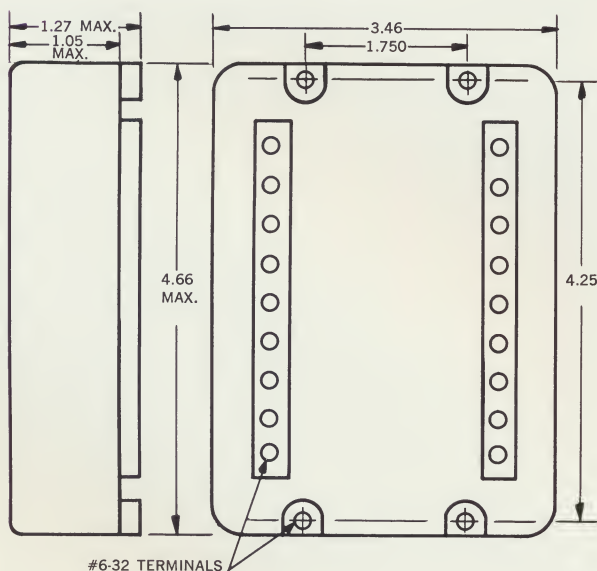
Standard modules permit tailored instrumentation free of unwanted features.

Lowest Maintenance:

Replacement of factory repairable modules minimizes maintenance, simplifies troubleshooting.



SINGLE-WIDTH MODULE



DOUBLE-WIDTH MODULE

COLOR CODED BY FUNCTION

Function Modules can be instantly identified by their color. This partial list* illustrates the variety of modules available under each color coded type of function:

INPUT SIGNAL CONVERSION (GREEN)

- 19-101A Millivolt Preamplifier
- 19-102 Milliamp Input
- 19-105 Voltage Follower
- 19-106 Pulse Rate Converter
- 19-116 D-C Input Converter

OUTPUT SIGNAL CONVERSION (WHITE)

- 19-201 Milliamp Output
- 19-202 Milliamp Output (High Load)
- 19-209 Memory-Milliamp Output
- 19-210 Voltage to Frequency Converter
- 19-211 Counter Drive (Black)

ALGEBRAIC FUNCTION (YELLOW)

- 19-301 Adder/Subtractor
- 19-302 Multiplier/Divider
- 19-303 Square Root
- 19-306 Function Segment (Adjustable)
- 19-308 10-Turn Coefficient Potentiometer
- 19-309 Multiplier
- 19-313 3-Channel Summing Selector
- 19-315 Inverse 10-Turn Coefficient
- 19-316 Square Root with Reference

DYNAMIC RESPONSE FUNCTIONS (BLUE)

- 19-407 Dynamic Response Module available as:
 - Sample and Hold
 - Integrator
 - Proportional Plus Reset
 - First Order Lag
 - Differentiator
- 19-412 Adjustable Lag
- 19-415 Rate Switch

LOGIC FUNCTIONS (RED)

- 19-501 Comparator
- 19-502 Amplitude Selector
- 19-508 Alarm

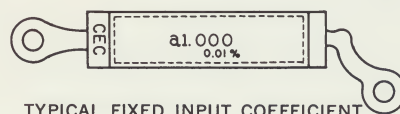
POWER SUPPLIES (BLACK)

- 19-601A ± 18 Volt Supply (300 ma)
- 19-603 ± 10 Volt Reference (Orange)
- 19-612 Floating Supply
- 19-611A ± 18 Volt Supply (150 ma)

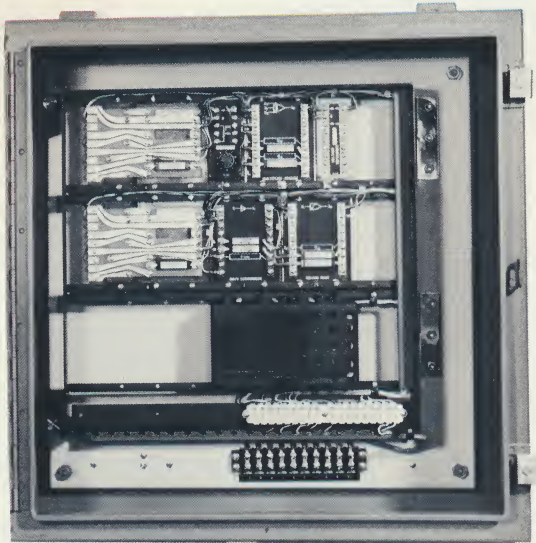
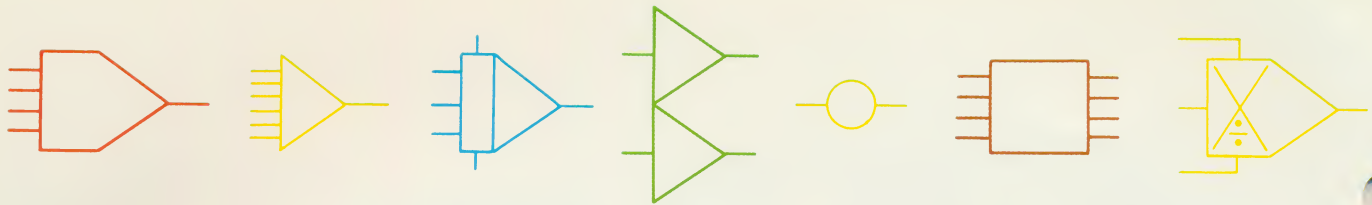
*For a complete list of Function Modules and prices refer to the enclosed price list, or contact your CEC/Devar Representative.



TYPICAL DIGITAL COEFFICIENT SELECTOR

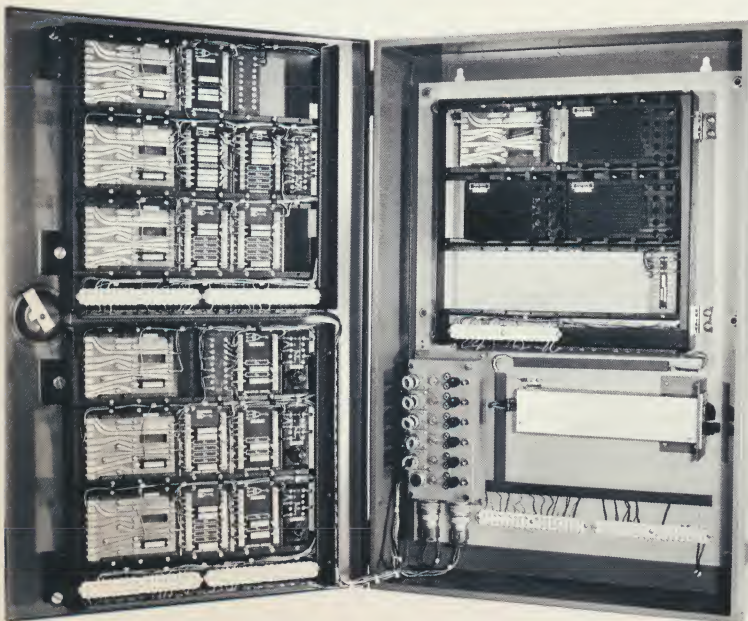


TYPICAL FIXED INPUT COEFFICIENT



HEAT TRANSFER RATE COMPUTER (above) Composed of eight Function Modules, this computer performs the algebraic equation $k \sqrt{\Delta P} \times \frac{\Delta T_1}{\Delta T_2}$. It is shown mounted in a 15-module cabinet.

RATIO COMPUTING SYSTEM (below) This computer (composed of 26 Function Modules) has six inputs and provides three outputs which solve equations of the form, $k \left(\frac{\Delta P_1}{\Delta P_2} \right)$ and an additional output $\Delta P_1 (1 - k \Delta T)$. The computer is mounted in a 48-module cabinet.



APPLICATIONS

To facilitate the design of systems using CEC/Devar Function Modules, inputs and outputs are connected without intermediate conditioning devices. Nominal inputs and outputs are ± 10 volts.

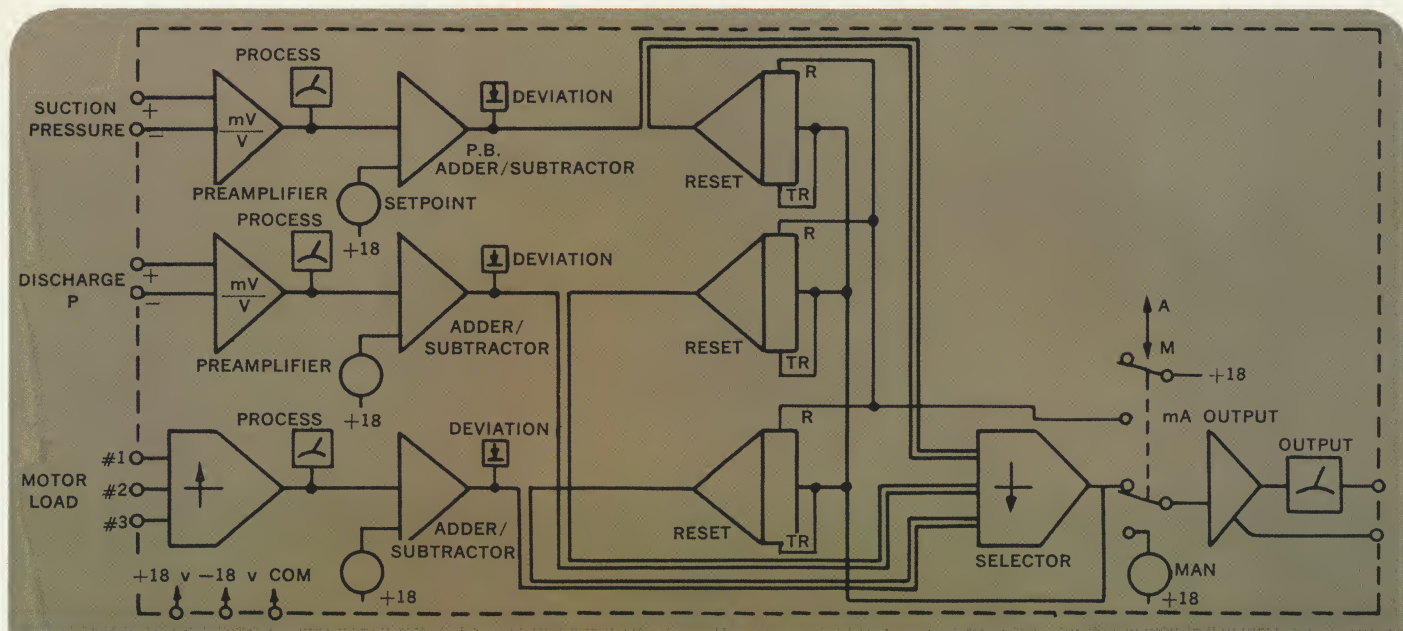
As previously noted, variables are scaled externally by encapsulated coefficient resistors fastened to the terminal face of the module. The elimination of zero and gain trimming devices is made possible by the use of high gain low drift amplifiers and .01% computing resistors.

Dimensions of all modules are related for flexibility of system design—and, because each function may be combined with over 50 others, use in the creation of simple or complex systems is virtually unlimited.

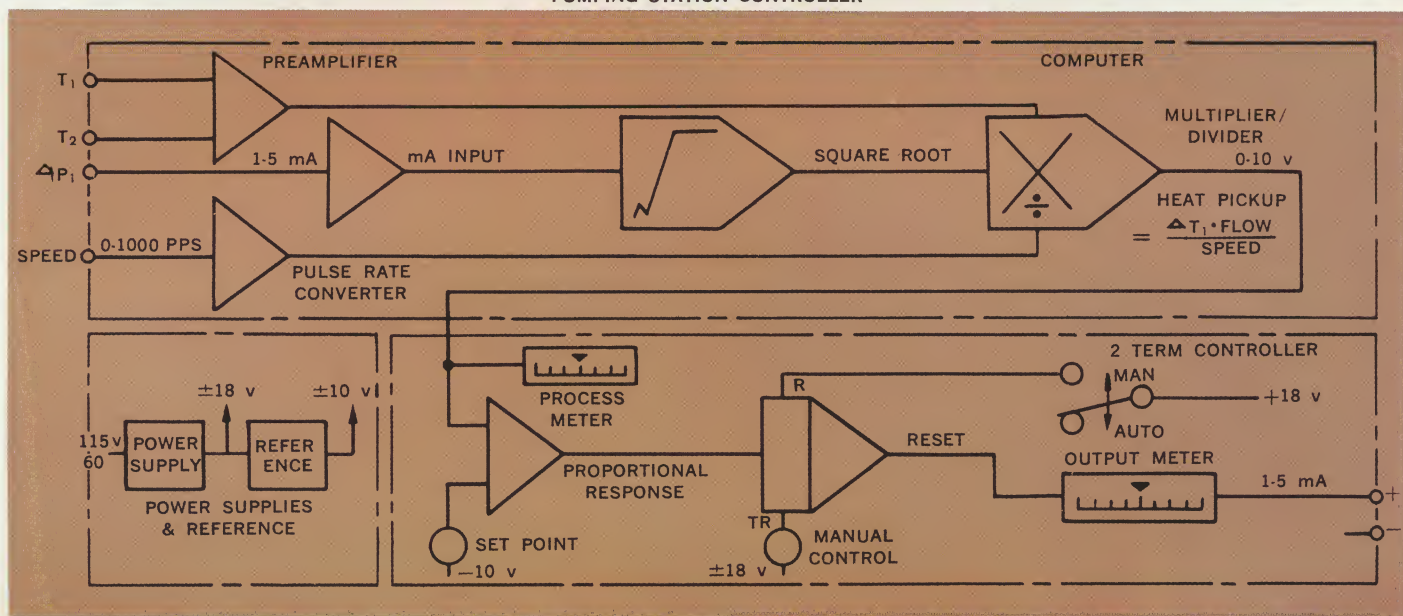
UNLIMITED RANGE OF USES

New applications for CEC/Devar Function Modules are being developed continually. A sampling of systems which have been designed employing Function Modules illustrates the broad scope of the Modules' versatility. Systems include: Ratio Controller, Material Composition Computer, Heat Transfer Rate Computer, Stress Computer, Cement Blending Computer, Process Simulator, Conveyor Flow Rate Computer, Dead Time Simulator, Air/Fuel Ratio Computer, Gas Flow Computer, Density Computer, Internal Reflux Computer, Bin Filling Logic and Safety System, Sequential Program Control, FM Wire Transmission, Watt Computer, Sample Weighing System, Flow Blending Computer, Pneumatic Output Set Point Storage, Remote Set Point Controller, Level Control with Inactive Zone, Temperature/Pressure Override Control, Pipeline Pumping Station Control, Feed-Forward Temperature Control. These specific systems can be used in applications such as: Refinery Computer Control, Boiler Startup Simulator, Nuclear Reactor Controls, and Reactor Test Loop Instrumentation. For complete information regarding application of CEC/Devar Function Modules to your specific requirements, call your nearest CEC/Devar Sales Office.

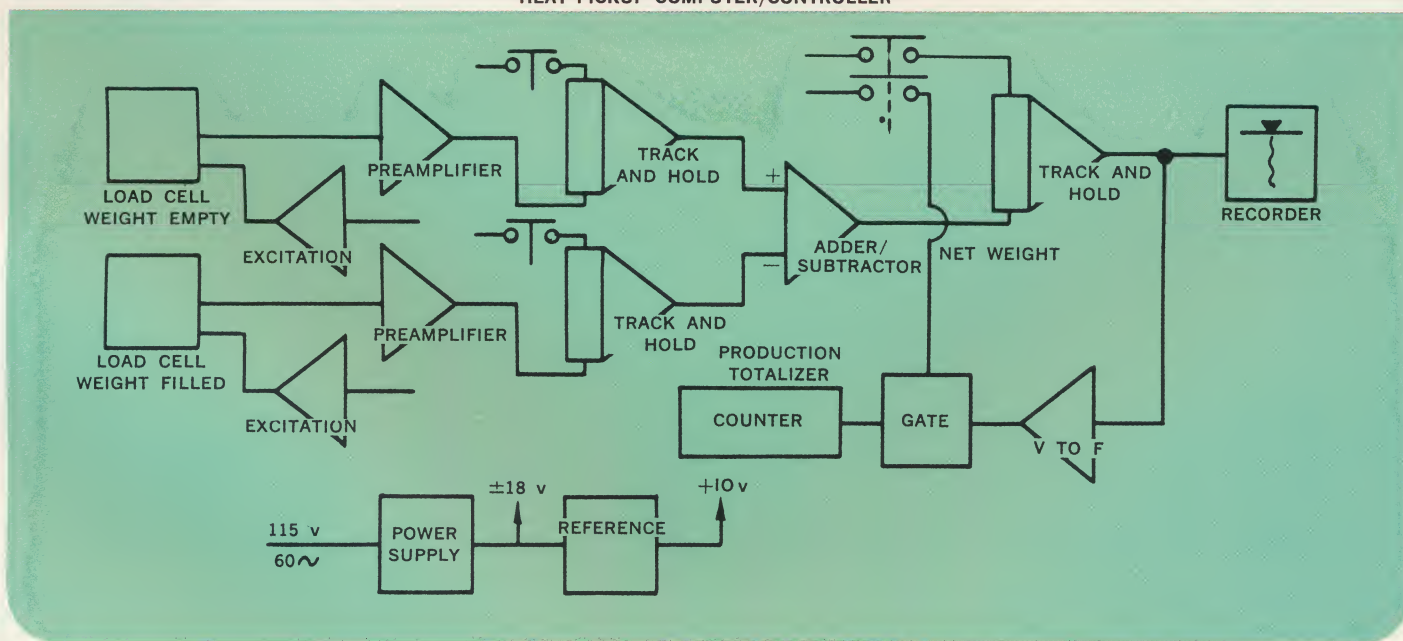
TYPICAL FUNCTION MODULE SYSTEMS



PUMPING STATION CONTROLLER



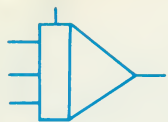
HEAT PICKUP COMPUTER/CONTROLLER



WEIGHING SYSTEM

FUNCTION MODULES GENERAL SPECIFICATIONS

Calibration and Scaling	Modules are scaled by mounting calibrating elements on the module screw terminals. Zero offsets are trimmed internally prior to encapsulation. Zero offset tolerance: 0.1% at the output for most modules. Coefficient element tolerances: 0.01% for computing resistors.	
Standard Module Output Specification	Nominal range: 0 to 10 volts. Maximum range: ± 14 volts at 1 ma. Maximum load: ± 20 milliamperes. Maximum capacitance load: 0.002 mfd. Effective source resistance: 0.1 ohm, max. Internally generated noise: Less than 10 millivolts peak-to-peak.	
Millivolt Input Conversion	Principle of operation: Transistor chopping at 3 kc. Potentiometric feedback by means of square wave and toroidal transformer coupling. Zero offset tolerances (referred to input): a. 40 to 120°F ambient: ± 50 microvolts. b. 0 to 1000 ohms source: ± 50 microvolts. Common mode rejection: a. at d-c: Infinite. b. at 60 cps: 110 db. Input insulation: 20,000 megohms at 200 volts. Gain and offset calibration: Adjustable in the field by toroidal transformer turns ratio and trimmer. Thermocouple compensation: Can be set in the field to desired compensation rate. Thermocouple burnout protection: Accessory available, either upscale or downscale. Outputs: Either standard 0 to 10 volts described above, or current output ranges up to 20 ma.	
Milliamp Input Conversion	Principle of operation: Bias and dropping resistors followed by voltage follower. Standard inputs: 1 to 5, 4 to 20, and 10 to 50 milliamperes. Full scale voltage drop: 10 volts. Grounding: Negative input is COMMON. Output: Standard specification.	
Pulse Rate Conversion	Principle of operation: Triggered precision operational amplifier integrator generates pulses of precise amplitude and duration. Filtered output is proportional to pulse rate. Standard ranges: 0 to 100, 200, 500, 1000 pps. Input requirements: 0.1 volt, 40 microseconds, minimum. Output: Standard specification. Output ripple: Less than 0.1% above 15 pps. Time constant: Less than 1 second.	
Voltage Follower	Principle of operation: d-c differential amplifier. Gain: $1.000 \pm 0.05\%$. Offset voltages: $\pm 0.1\%$ Input current: 10^{-11} amperes, max. Output: Standard specification.	
Milliamp Output Conversion	Principle of operation: Current sensing resistor between output load and common. Operational amplifier with input	and feedback resistor elements. Standard output: 1 to 5 ma into 2800 ohms, 4 to 20 ma into 700 ohms, or 10 to 50 ma into 200 ohms. Load requirement: Must be isolated from ground. NOTE: An alternative function module is available for use when load is grounded or when a large voltage drop is required across an ungrounded load.
	Memory with Milliamp Output	Principle of operation: Storage capacitor and operational amplifier having extremely high current gain. Modes of operation: Either track and hold or integrate and hold. Storage drift rate: Less than 0.2% per hour, diminishing to 0.1% per hour after first hour at any level. Output: 1 to 5 ma into 2800 ohms. Input: 0 to 10 volts d-c or voltage pulses.
	Voltage to Frequency Conversion	Principal of operation: Operational amplifier integrator with precision RC network is compared to ± 10 volt references. Solid-state switches reverse direction of integration at each intercept. Standard output ranges: From 0 to 0.1 pps to 0 to 1000 pps.
	Linear Combining Functions	Principle of operation: Operational amplifier and precision resistors. Zero offset tolerance: $0.1\% \left(\frac{\text{Gain} \pm 1}{2} \right)$. Gain tolerance: 0.03%. Bandwidth: Less than 3 db down to 10 kc. Output: Standard specifications.
	Non-Linear Functions	Principle of operation: Pulse ratio modulation. Output tolerances (positive quadrants): a. Multiplier: 0.1%. b. Square rooter: 0.1% at full scale output, 1% at 10% output. c. Divider: 0.1%, increasing as divisor decreases. Bandwidth: Static accuracy maintained to 5 cps. Less than 3 db down at 100 cps. Output: Standard specification.
	Amplitude Selector Functions	Principle of operation: Operational amplifier for each channel feeds output amplitude through diodes, to form precision selector. Selector resolution: 0.01%. Output: Standard specification.
	Dynamic Control and Compensation	Time constant range: 1/10 second to 20 minutes. Zero frequency integrator gain: a. Worst case: 300 at 20 minute setting and 120°F. b. Typical: Greater than 10,000. Zero drift referred to input: a. Long term: 0.1%. b. 95 to 130 volt supply: 0.01%. c. 40 to 120°F: .05% per 50°F, max. Proportional response bandwidth: Less than 3 db down at 10 kc. Time constant value tolerances: 10% increasing to 40% for very large values.



Dynamic Control with Boundaries or Amplitude Selection

Principle of operation: Nonsaturating feedback networks and amplifiers and fast recovery forward amplifier. Forward amplifiers include boundary limits and selector diodes.

Reset "wind-up": None.

Circuit recovery time: 1 millisecond, max.

Selector resolution: 0.01%.

Output: Standard specification, except limited to 1 milliamperere loads.

Amplitude Comparator

Principle of operation: Operational amplifier summing.

Accuracy of trip point: 0.1%.

Response time: 2 milliseconds.

Differential gap: Set by external resistor element.

Output: Standard specification.

± 18 Volt Power Supply

Output voltage: ± 18 volts $\pm 0.5\%$.

Maximum rated load: ± 300 milliamperes.

Input: 100 to 130 volts, 50 to 400 cps.

± 10 Volt Reference

Supply effect: 0.025%.

Load effect: 0.025%.

Ambient temperature effect: $\pm 0.5\%$ per 50°F .

Output voltage: ± 10 volts $\pm 0.025\%$.

Other output characteristics: Standard.

Ambient temperature effect: $\pm 0.1\%$ per 50°F .

Circuit Construction

Electrical components mounted on glass-epoxy printed circuit boards with through-plated holes for reliable soldered connections.

Encapsulation

Circuits mounted in impact resistant polycarbonate resin case and encapsulated for protection from moisture, dirt, rapid temperature changes, and vibration.

Repair

Systems are repaired by module replacement. Modules are factory repairable.

Wiring Terminals

Each module has eighteen external wiring terminals for use in making reliable external connections and mounting scaling and biasing elements.

CEC/DEVAR FUNCTION MODULE INSTRUMENTATION

Instrumentation constructed using CEC/Devar Function Modules simultaneously achieves best performance, most usefulness, and highest reliability—at lowest cost.

All instruments and instrumentation systems employ Function Modules which means *Coherent Design*—the uniform use of operational-amplifier circuitry for all units.

CEC/Devar instrumentation, thus, has many unique advantages.

Versatility Virtually any combination of functions can be employed to give instruments any degree of computational sophistication.

Operational Compatibility Using a standard 0 to 10 volt signal, up to 20 modules can fan out from a single module without changing the output.

Permanent Calibration Users never recalibrate Function Modules.

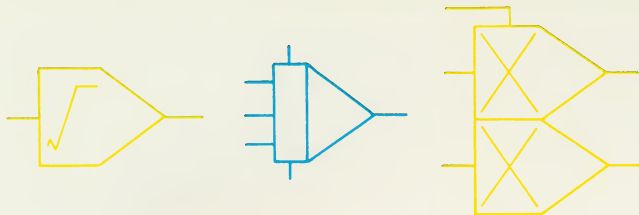
Freedom From Drift and Noise Drift produced by ambient conditions is negligible. Internally generated noise is virtually non-existent.

Mounting Convenience Uniform in size and shape, modules mount in any combination inside standard CEC instruments, cases, and racks.

Ruggedness Hard wiring, screw terminals, encapsulation, and solid-state components make Function Modules impervious to corrosion, dirt, vibration and heat—guard instruments against substantial abuse.

Equally useful in the experimental laboratory, pilot plant, and full scale process plant, CEC Function Module instruments produce information which is uniform in quality.





TRANSMITTERS

Transmitters for millivolt, strain gage, and resistance amplification are supplied in a case for two channels, a dual case for four channels, and a two-channel case with millivolt to pneumatic transducer. Each transmitter has a self-contained power supply with optional battery backup.

With linearity of better than 0.2%, these accurate drift-free, chopper stabilized amplifiers feature isolated input for high rejection of common-mode noise. Output of the amplifier is 1-5 or 4-20 ma d-c. Hysteresis of the 3-15 psig transducer is 0.15 full scale.

Spans up to 200 mv d-c and offsets up to ± 50 mv are easily adjustable on the amplifier input module using a unique straight-through inductive calibration technique. Wires are simply looped through transformers encapsulated into the input module. Trimpots are mounted on the outside of the module. Thermocouple compensation resistors are built in.

Transmitters are serviced easily by replacement of factory repairable modules. Generous allowances are made on replacement modules when returned modules are in repairable condition.

These transmitters are available with a wide variety of accessories and modifications which include alarms, exciters, battery backup in the power supply for line-power failure, thermocouple break protection, operation from a d-c source, inverse temperature compensation, and various input and output modifications. For complete information see CEC Bulletins 18105 and 18107.

PREAMPLIFIERS

CEC millivolt preamplifiers have an accuracy of better than $\pm 0.1\%$. They introduce a new high order of performance, reliability and flexibility—at a low cost. The 19-101A is a solid state, chopper stabilized, high-gain amplifier designed to convert d-c mv signals to the level required for use in precision indicating, recording, computing, and data systems.

Common mode rejection is infinite at d-c, 110 db at 60 cps. Span is continuously adjustable from 5 to 200 mv. Offset is continuously adjustable ± 50 mv. Output is nominally 0 to 10 volts d-c with 1 to 5 ma and 4 to 20 ma optional.

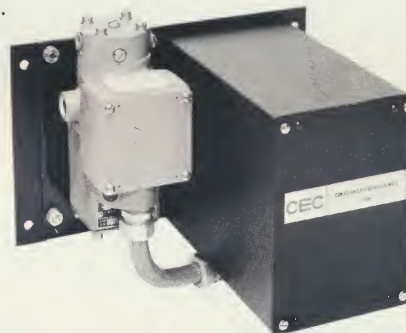
Designed for flexible installation, up to ten 19-101A Preamplifiers can be installed in a 19-inch rack or in any CEC surface-or-wall-mounting case. A power supply (19-601A) is available for use with the 19-101A Preamplifier. For complete information see CEC Bulletin 19101.



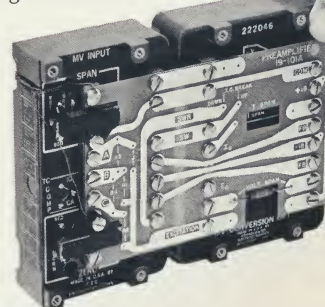
Type 18-105 Millivolt Transmitter with two channels in a single case houses a preamplifier and power supply.



Type 18-106 Millivolt Transmitter with four channels in a dual case holds three preamplifiers and a power supply.



Type 18-107 Millivolt to Pneumatic Transmitter with two channel case and 3-15 psig transducer



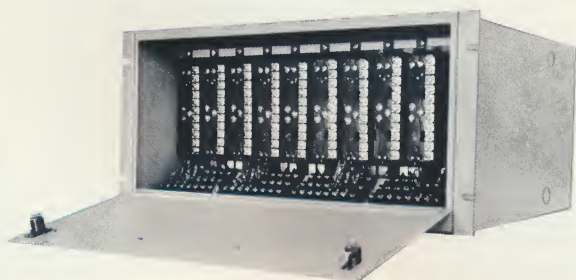
Type 19-101A Millivolt Preamplifier



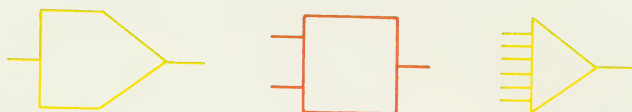
18-300 Series Recorder



18-400 Series Controller



Millivolt preamplifiers shown installed for rack mounting.



RECORDERS

Highly versatile 18-300 Series Recorders are offered with standard Function Module channels to handle 1 to 50 volt inputs, or milliamp d-c inputs in ranges of 1 to 5, 4 to 20, or 10 to 50 milliamp. Also, Function Modules may be employed to provide many special inputs such as d-c millivolts and frequency—plus computed inputs received from Function Module computer systems.

One-, two-, or three-pen models are offered, with all pens providing simultaneous full-scale rectilinear operation. The recorder case is capable of housing a power supply and complete BTU, ratio, or similar equation. For complete ordering information refer to CEC Bulletin 18301.

CONTROLLERS

Available in one, two, and three mode configurations, CEC 18-400 Series Indicating Controllers offer off-the-shelf adaptability for specialized control requirements. Operating from all the same type inputs as CEC/Devar recorders, the indicating controllers are easily changed from one mode arrangement to another simply by replacing a Function Module. Furthermore, because circuitry consists of Function Modules, standard-price quotations, even for exotic systems, can be determined immediately. Function Module circuitry also assures low instrument cost and fast delivery.

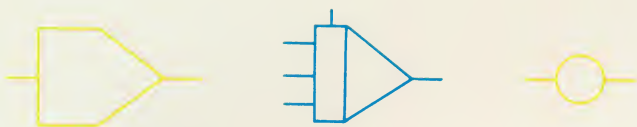
Series 18-400 Controllers can be fitted with Function Modules for standard applications such as cascade, ratio, bias, computer set-point memory, summing, and auto-ratio control.

Features available include: signal conversion and filtering, rate response to a process signal, deviation indicator, and anti-reset windup.

Controllers also can be teamed with Function Module control systems described below to achieve any degree of computational or control complexity. For complete information, see CEC Bulletin 18401.

CUSTOM PRODUCTS

Systems of Function Modules make possible economical computational control of difficult-to-control processes. Included among these systems are feed-forward control, multi-stream blending, programmed control, and flow computation. Applications include process optimization, plant simulation, efficiency determination, process monitoring, and program analysis. For complete information and system quotation, contact the Devar-Kinetics Division.



PACKAGING OPTIONS

FUNCTION MODULE FRAMES

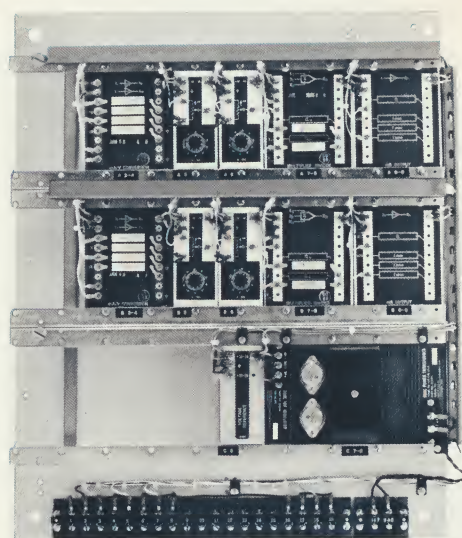
Frames which hold up to five double-width Function Modules are available for mounting on panels and other surfaces. A 21 x 17-inch plate which accommodates up to three frame sets (15 double-width modules and external wiring blocks) is available for bolting to any surface. Plates are designed for installation in CEC standard wall mounting cases described below.

WALL MOUNTING CASES

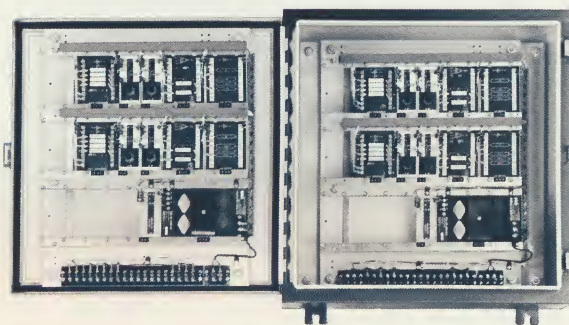
A wall mounting case with space for up to 30 double-width modules holds two standard plate and frame assemblies. The 24 x 24 x 8-inch wall mounting box is oil and dust tight. An air purge kit is available.

SURFACE MOUNTING CASES

Two weatherproof surface mounting cases are offered—single and dual. Each single case accommodates up to four double-width Function Modules. Modules mount on channels composed of top-and-bottom rails which slide into the case. Each channel holds two double-width modules. The assembly also includes a front facing external-terminal block with 13 screw terminals. The cases are 9 1/8-inches deep. The base of the single case occupies a space 7 1/2" high by 7" wide, and the dual case a space 7 1/2" high by 13" wide.



Function Module frames installed on standard plate.

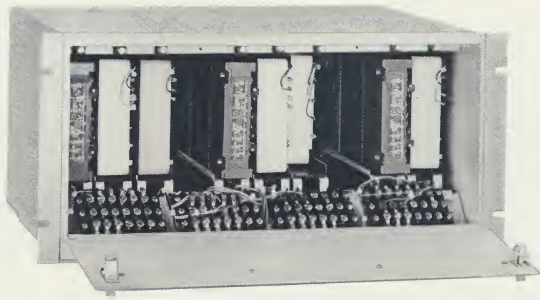
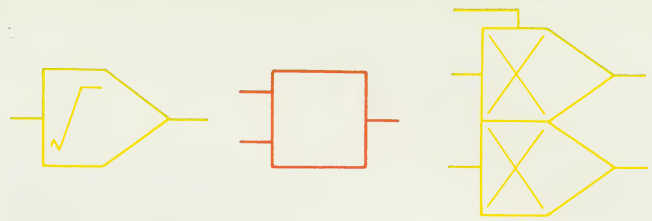


Wall mounting case with plate and frame assemblies shown in position.

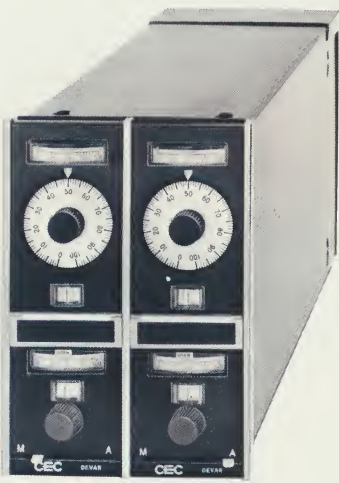


Single surface mounting case

Dual surface mounting case



Ten channel rack mounting case



Double-width panel mounting case with two indicating controllers shown installed.



Multiple unit adapter for standard 19-inch relay rack, four controllers and a recorder installed.

TEN CHANNEL RACK MOUNTING CASE

This case holds up to ten Function Module channels with five single-width module spaces per channel. Air purging and up to ten engraved service tags are available. Also, a choice can be made between front or rear field wiring terminals. In either case, the front wiring terminals provide service test points and means for disconnecting individual channels.

PANEL MOUNTING CASES

Available in single-width and double-width versions, these cases house controllers and Function Module systems. The single-width case is $2\frac{7}{8}$ " wide x $8\frac{1}{16}$ " high x $20\frac{3}{8}$ " long. The double-width case is $5\frac{1}{4}$ " wide x $8\frac{1}{16}$ " high x $22\frac{5}{8}$ " long. The additional length of the double-width case accommodates a power supply.

Two chassis options are available. The long chassis holds up to nine single-width Function Modules. The short chassis holds only one single-width module and is primarily for panel mounted components.

Panel components available for use with these cases include meters, switches, coefficient, counters, tags, and annunciator lights.

MULTIPLE UNIT RACK MOUNTING ADAPTER

This rack adapter has three openings each of which accommodates a recorder case or a double-width panel mounting case. Designed for mounting in a standard 19-inch relay rack, the adapter is $10\frac{15}{32}$ inches high.

SERVICES

APPLICATION ENGINEERING

The CEC/Devar Application Development Group has the major objective of continuously preparing detailed information covering a wide range of applications. This information, as it is produced, is made available to users and prospective users in the form of Custom Product Applications and Function Module Application Instructions.

Design of Function Module systems follows standard textbook techniques. Thus, many users are able to accomplish their own engineering without difficulty. Whenever necessary, CEC/Devar is glad to provide application assistance.

MAINTENANCE

CEC/Devar Function Modules are factory repairable; therefore, module maintenance is eliminated. System repair, if necessary, is done simply by module replacement. Because modules have extremely long life and are completely interchangeable, it is necessary for users to keep only a modest supply of spares in stock. For 24-hour replacement service, just TWX CEC/Devar.

One Year Warranty

Function Modules all have a One Year Warranty. This warranty provides for module replacement if, during the first year of operation, any malfunction results from defective materials, components, or construction.

Liberal Trade-in Policy

If module replacement becomes necessary after expiration of the warranty period, credit of 60% of the original module cost is allowed for exchange modules returned to CEC/Devar in repairable condition.

SERVICE

Systems employing Function Modules frequently include a large number of other CEC/Devar control instruments and equipment such as recorders, controllers, converters, and valves. If startup assistance is desired, on-site assistance of CEC/Devar engineers can be arranged at nominal cost.

ORDERING INFORMATION

An Application Questionnaire and Function Module Price List are enclosed with this bulletin to assist you in determining your Function Module requirements. If a quotation on a Function Module system is desired, please fill in the questionnaire giving as much information as possible and send it directly to CEC/Devar. The information will be delivered to you promptly by your local CEC/Devar salesman.

DE VAR-KINETICS DIVISION

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OF BELL & HOWELL • FINER PRODUCTS THROUGH IMAGINATION

WHAT ARE YOUR CONTROL SYSTEM REQUIREMENTS?

To facilitate discussion of a system tailored to your specific requirements, please fill in and mail the following questionnaire to CEC/Devar.

1. System description or diagram:

1a. Formula to be solved:

2. Signals (ranges, typical values, frequencies):

Inputs

Outputs

3. Accuracy required:

Panel Mounting _____ Rack Mounting _____ Wall Mounting _____

RETURN ADDRESS INFORMATION

Please return information to:

Name _____

Position _____

Company _____

Street _____

City _____ State _____ Zip _____

Phone _____

DE VAR-KINETICS DIVISION

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706 BOSTWICK AVE., BRIDGEPORT, CONNECTICUT

FUNCTION MODULES

This price list is for CEC/Devar Function Modules. It contains a description of each module by Type Number and Function. In addition to price for each module, the list shows power drain, coefficients required, 10V Reference required, and module size.

All prices F.O.B. Bridgeport, Connecticut.

Prices subject to change without notice.

Terms net 30 days.

Effective January 1, 1966

FUNCTION MODULES

Catalog No.	Function	Price	Power Drain		Coefficients Type No. not included in module prices See PL-671B	10v Ref. Req.	Module Size See Note 1
			+ 18v	− 18v			
INPUT SIGNAL CONVERSION							
19-101-A	Millivolt Preamplifier	275.00	19ma	27ma	1 for 4-20 ma output only See Options		2-D
19-102-1	Milliamp Input-1 Channel	50.00	See Note #2		Input Span 1		1-D
19-102-2	Milliamp Input-2 Channel	80.00	See Note #2		Input Offset 1		1-D
19-105-1	Voltage Follower-Single Channel	45.00	4ma	4ma	Input Span 2		1-D
19-105-2	Voltage Follower-2 Channel	75.00	8ma	8ma	Input Offset 2		1-S
19-106-1	Pulse Rate Converter (0-1000pps)	200.00	20ma	20ma	None None	10ma (−10v)	1-S
19-106-2	Pulse Rate Converter (0-10,000pps)	200.00	20ma	20ma	Input Span 1 Trimmer 1	10ma (−10v)	1-D
19-116	DC Input Conversion Module	50.00	See Note #2		See Note #3		
OUTPUT SIGNAL CONVERSION							
19-201	Milliamp Output (Floating Load)	60.00	See Note #4		Output Span 1 Output Offset 1		1-D
19-202	Milliamp Output (Load to Common)	90.00	See Note #5		Output Span 2		1-D
19-205	Current-to-Air	160.00			None		Not Module
19-209	Memory-Milliamp Output	215.00	20ma	20ma	Output Span 1 Output Offset 1 Time Sel. (Inv.) 1 as Integrator		1-D
19-210-1	Voltage-to-Frequency (0-100pps)	215.00	22ma	22ma	Output Span 1 Trimmer 1		1-D
19-210-2	Voltage-to-Frequency (0-1000pps)	220.00	22ma	22ma	Output Span 1 Trimmer 1		1-D
OUTPUT SIGNAL CONVERSION							
19-211	Counter Drive	100.00	4ma	4ma	None 0	Requires 115VAC 20VA max.	1-D
ALGEBRAIC FUNCTIONS							
19-301	Adder/Subtractor	100.00	10ma	10ma	Input Gain Up to 6 Output Gain 1		1-D
19-302	Multiplier/Divider	340.00	35ma	28ma	Input Gain Up to 3	1 ma if used as Mult. or Divider only	1-D
19-303	Square Root	195.00	30ma	25ma	Input Gain 1 or 2 Output Gain 1	1ma	1-D
19-306	Function Segment-Adj. Cal. Dial	150.00	7ma	7ma	None 0		1-S
19-306-2	Function Segment-Adj. Blind Dial	115.00	7ma	7ma	None 0		1-S
19-308	10-Turn Coefficient Potentiometer	75.00	5ma	5ma	None		1-S
19-315	10-Turn Coefficient Potentiometer (Inverse)	75.00	5ma	5ma	None		1-S
19-309	Multiplier	265.00	35ma	28ma	Input Gain Up to 3 Output Gain 1	1ma	1-D
19-313	3 Channel Summing Selector	200.00	30ma	30ma	Diode Coeff. 3		1-D
19-316	Square Root with Reference	230.00	35ma	30ma	Input Gain 1 or 2 Output Gain 1		1-D

FUNCTION MODULES

Catalog No.	Function	Price	Power Drain		Coefficients Type No. not included in module prices See PL-671B	10v Ref. Req.	Module Size See Note 1
			+ 18v	− 18v			
DYNAMIC RESPONSE FUNCTIONS							
19-407	Dynamic Response Module available as: Track & Hold Integrator Differentiator	215.00	14ma	14ma	None 0 Time (Inv) 1 or 2) Time 1 or 2) See Note 6 Capacitor Element 1) Time Sel. (Inv) 1 or 2 (Requires 19-612 Floating P.S.) Feedback 1		1-D
19-412	Adjustable Lag	175.00	12ma	12ma			1-D
19-415	Rate Switch	165.00	11ma	11ma			1-D
LOGIC FUNCTIONS							
19-501-1	Comparator-1 Channel	50.00	4ma	4ma	Input Gain 2 Delta Coeff. 1 Zener Coeff. 1		1-D
19-501-2	Comparator-2 Channel	80.00	8ma	8ma	Input Gain 4 Delta Coeff. 2 Zener Coeff. 2		1-D
19-502	Amplitude Selector	200.00	25ma	25ma	Diode Coeff. 2 to 4		1-D
19-504	Signal Selector Switch (Dual)	75.00	10ma	10ma	None		1-S
19-508-1	Alarm Module with Relay	50.00	12.5ma	14ma	Diode Element 1		1-S
19-508-2	Alarm Module without Relay	40.00	2.5ma	14ma	Diode Element 1 or Zener Element 1		1-S
19-509	Memory/Not	75.00	10ma	10ma	None		1-S
19-510	Time Delay	110.00	10ma	10ma	None		1-S
19-511	Dual Not	70.00	10ma	10ma	None		1-S
19-512	Dual Amplifier	70.00	10ma	10ma	None		1-S
19-513	“And” Gate	30.00	See Note #7		Bias Resistor (1 per gate)		1-S
19-514	“Or” Gate	30.00	See Note #7		Bias Resistor (1 per gate)		1-S
19-515	Deviation Comparator	125.00	10ma	10ma	None		1-S
ACCESSORY MODULES							
19-601-A	Power Supply (±18v, ±300ma)	140.00				115VAC 60 cps 25VA Max.	2-D
19-603	Reference (±10v)	100.00	20ma	10ma	None 0		1-S
19-611	Power Supply (±18v, ±150ma)	100.00			None 0	115VAC 60 cps 15VA Max.	1-S
19-612	Floating Power Supply	85.00	12ma	12ma			
LOGIC FUNCTION-ACCESSORIES							
221888-01	Relay Module- 1 Channel	18.00	10ma	10ma	None 0		1-S
221888-02	Relay Module- 2 Channels	25.00	20ma	20ma	None 0		1-S
221888-03	Relay Module- 3 Channels	35.00	30ma	30ma	None 0		1-S
221888-04	Relay Module- 4 Channels	45.00	40ma	40ma	None 0		1-S
INPUT CONVERSION-OPTIONS							
19-101-A	MV Preamplifier Options:						
222798-01	Thermocouple Break Protection	+ 6.00					
222798-02	Resistance Bulb Input	+15.00					
222798-03	Differential Bulb Input	+15.00					
222798-04	Input Voltage Divider	+15.00					
222798-05	Strain Gage Safety Resistor	+ 2.00					
222798-06	16ma Span	+ 3.00					
222798-07	End Access Terminal Block	+11.00					
222798-08	Inverse Temperature Compensation	+15.00					
222798-09	Narrow Span (less than 4mv)	+15.00					
222798-10	Fast Response Input	+12.00					

COEFFICIENT ELEMENTS FOR FUNCTION MODULES

Coeff. Type	Coeff. Toll	Symbol & Value	Component Value	Fits Modules Type	Ordering Part No.	Price
INPUT GAIN (Fixed)	0.01%	a 8.000	2,500	19-301 19-302 19-303 19-309 19-316 19-501	222017-01)	7.50
		a 4.000	5,000		222017-02)	
		a 2.000	10,000		222017-03)	
		a 1.000	20,000		222017-04)	
		a 0.800	25,000		222017-05)	
		a 0.500	40,000		222017-11)	
		a 0.400	50,000		222017-06)	
		a 0.250	80,000		222017-13)	
		a 0.200	100,000		222017-07)	
		a 0.100	200,000		222017-08)	
ANY VALUE BETWEEN ABOVE LIMITS—SPECIFY GAIN REQUIRED						
INPUT GAIN (Selector)	1.0%	a 1, 2, 4, 8	As above	19-301, 302	222023-01)	20.00
		a .1, .2, .4, .8		19-303, 501	222023-02)	
				19-309, 316	)	
OUTPUT GAIN (Fixed)	0.01%	ao 5.000	100,000	19-301 19-302 19-303 19-309, 19-316	222020-01)	7.50
		ao 2.500	50,000		222020-09)	
		ao 2.000	40,000		222020-02)	
		ao 1.000	20,000		222020-03)	
		ao 0.500	10,000		222020-04)	
ANY VALUE BETWEEN ao 0.1-10.00—SPECIFY GAIN REQUIRED						
OUTPUT GAIN (Selector)	1.0%	ao .1, .2, .4, .8	As above	19-301, 302 19-303, 309, 19-316	222154-01)	25.00
MA INPUT SPAN	0.01%	4ma (1-5ma)	2903.2	19-102	222100-06)	7.50
		16ma (4-20ma)	725.8		222100-07)	
		40ma (10-50ma)	290.32		222100-08)	
MA INPUT ZERO OFFSET	0.01%	1ma (1-5ma)	18,000		222101-08)	
		4ma (4-20ma)	4,500		222101-09)	
		10ma (10-50ma)	1,800		222101-10)	
FREQ. INPUT SPAN (FIXED)	0.01%	1,000pps	2,000	19-106-1	222145-01)	7.50
		500pps	4,000		222145-03)	
		100pps	20,000		222146-05)	
		200pps	10,000		222145-04)	
		10,000pps	2,000	19-106-2	222145-20)	
			Trim Element	2,000 F.S.	19-106, 19-210	222595-01)
MA OUTPUT SPAN	0.01%	4ma (1-5ma)	400	19-202	222100-19)	7.50
		16ma (4-20ma)	98.52		222100-20)	
		40ma (10-50ma)	39.29		222100-21)	
MA OUTPUT ZERO OFFSET	0.01%	1ma (1-5ma)	144K	19-201	222101-15)	
		4ma (4-20ma)	144K		222101-16)	
		10ma (10-50ma)	144K		222101-17)	

COEFFICIENT ELEMENTS FOR FUNCTION MODULES

Coeff. Type	Coeff. Toll	Symbol Value	&	Component Value	Modules Type	Part No.	Price
FREQ. OUTPUT SPAN (FIXED)	0.1% 0.01%	0.1 cps 1.0 cps 1.111 cps 10 cps 11.111 cps 25 cps		2.5M 250K 225,020 25,000 22,502 10,000	19-210-1	222145-14- 222145-13) 222145-15) 222145-12) 222145-16) 222145-17)	30.00 7.50
ANY VALUE BETWEEN 0.1-109cps—SPECIFY CPS Req'd.							
FREQ. OUTPUT SPAN (fixed)	0.01%	100 cps 1000 cps		25,000 2,500	19-210-2	222145-11) 222145-10)	7.50
ANY VALUE BETWEEN 100-1000cps—SPECIFY CPS Req'd.							
DIODE COEFF.	—	—		Silicon Diode	19-313 19-502	222132-01)	5.00
ZENER DIODE COEFF.	—	—		10V Zener Diode	19-501	222025-01)	7.50
DELTA COEFF. (fixed)	5%	0.25% 0.5% 1.0% 2.0%		80,600 40,200 20,000 10,000	19-501	222026-05) 222026-06) 222026-07) 222026-08)	7.50
INVERSE TIME SELECTOR (Input)	5%	100, 200 400, 800	R/M	200K, 100K 51K, 24K		222028-05)	
	5%	10, 20, 40 80 R/M		2M, 1M, 510K, 240K	19-407INT 19-412	222028-04))	
	5%	1, 2, 4, 8 R/M		20M, 10M 5.1M, 2.4M	19-209INT	222028-03)))	15.00
	20%	.1, .2, .4, .8 R/M		200M, 100M 51M, 24M		222028-02)))	
	30%	.01, .02, .04, .08 R/M		2x1000M, 1000M 500M, 240M		222028-01))	
FREQ. INPUT	0.01%	FREQ. INPUT		0.01%	FREQ. OUTPUT	0.01%	
TIME SELECTOR (Output)	5%	.001, .002 .004, .008 Min.		20K, 39K 82K, 160K		222027-01)))	
Note: Capacitor Element must be used in parallel with selector	5%	.01, .02, .04, .08 Min.		200K, 390K 820K, 1.6M	19-407 (Differentiator)	222027-02)))	
	5%	.1, .2, .4, .8 Min.		2M, 3.9M 8.2M, 16M		222027-03)))	15.00
	10%	1, 2, 4, 8 Min.		20M, 39M 82M, 160M		222027-04))	
		Capacitor Element		0.1MF		222070-04)	5.00
RATE SWITCH FEEDBACK BIAS RESISTOR	—	—	Two Silicon Diodes Back to Back		19-415 19-513 19-514	223364))	5.00
TIME TRIMMER CARD		Capacitor on Lugs		3MF	19-407 19-407	222070-06) See Note	20.00

COEFFICIENT ELEMENTS FOR FUNCTION MODULES

Coeff. Type	Coeff. Toll	Symbol & Value	Component Value	Fits Modules Type	Ordering Part No.	Price
RESISTOR ELEMENT	0.1%	1ma Bias	18K)		221764-48)	
		4ma Bias	4.5K)	19-116	221764-50)	
		10ma Bias	1.8K)	(10 or 1 volt drop)	221764-52)	
		4ma Span	2,903.2 ohms)		221764-57)	3.00
		16ma Span	725.8 ohms)	19-116	221764-58)	
		40ma Span	290.3 ohms)	(10v drop)	221764-59)	
		4ma Span	253.3 ohms)		222447-10)	
		16ma Span	63.33 ohms)	19-116	222447-11)	
		40ma Span	25.33 ohms)	(1v drop)	222447-12)	
			2.222K)	19-116	222447-09)	
				(gain=10)		
			20K)	19-116	221764-03)	5.00
			)	(gain=2)		
			5K)	19-116	221764-01)	3.00
				(gain=5)		

TIME TRIMMER CARDS COME IN THE FOLLOWING VERSIONS:

10 VOLT OUTPUT	SINGLE INPUT	223380-11	\$ 45.00
10 VOLT OUTPUT	TWO INPUTS	223380-12	72.50
10 VOLT OUTPUT	THREE INPUTS	223380-13	100.00
±10 VOLT OUTPUT	SINGLE INPUT	223380-21	45.00
±10 VOLT OUTPUT	TWO INPUTS	223380-22	72.50
±10 VOLT OUTPUT	THREE INPUTS	223380-23	100.00

STANDARD TIME CONSTANT RANGES ARE:

1-2	2-5	5-10	10-20	20-50
Seconds	Seconds	Seconds	Seconds	Seconds
Minutes	Minutes	Minutes	Minutes	Minutes
Hours	Hours	Hours		

DE VAR-KINETICS DIVISION

CEC

CONSOLIDATED ELECTRODYNAMICS

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